REMARKS

This amendment, submitted in response to the Office Action dated May 14, 2002, is believed to be fully responsive to each point of rejection raised therein. Accordingly, favorable reconsideration on the merits is respectfully requested.

As an additional preliminary matter, in the detailed Office Action, the Examiner has objected to Fig. 1 for illustrating multiple embodiments. Applicant submits proposed drawings to obviate this objection. Corresponding changes are also set forth in the specification.

Turning to the merits of the Office Action, claims 1-8 remain pending in the application with claims 1, 2 and 8 being withdrawn from further consideration at this time, pursuant to the Response to Election of Species Requirement previously filed. Claims 2-5 have been rejected under 35 U.S.C. § 103 as being unpatentable over Lazarev et al. (U.S.P. 5,986,271, hereafter "Lazarev") in view of Wilder et al. (U.S.P. 5,262,871, hereafter "Wilder"). Claims 6-7 have been rejected under Section 103 as being unpatentable over Lazarev and Wilder and further in view of Talmi et al. (U.S.P. 5,821,547, hereafter "Talmi"). Applicant submits the following arguments in traversal of the prior art rejections.

Applicant's invention relates to an imaging apparatus whereby image read out can be performed in an efficient and rapid manner. A known technique comprises detecting the autofluorescence of intrinsic dyes when irradiated with excitation light. However, the level of autofluoresecence is typically weak and prone to noise effects. In particular, a dark current due to diffused current introduces noise based on pixel size, exposure time, reading time, temperature and other conditions.

Applicant's invention, as illustrated by an exemplary embodiment in Fig. 1, obviates the above deficiencies. A CCD sensor 108 is disposed at the leading end of an endoscope 100. An illuminating unit 110 introduces excitation light to the subject being imaged 10. A CCD driver 120 controls operations of the CCD sensor. Details of the structure of the CCD sensor are illustrated in Fig. 2. The CCD image sensor comprises an array of n x (4/3)n pixels having a fluorescence imaging region 24 for imaging fluorescence and an area 25 which form a non-imaging area. The pixel array includes photodiodes where transfer charges through a vertical charge transfer 28 and a horizontal charge transfer 29. The non-imaging areas 25 are blocked by a thin metal film. The CCD driver 120 includes information which represent the locations of the fluorescence imaging region 24 and the non-imaging region 25. Conventional devices read out the charges stored in the horizontal charge transfer 29 at a predetermined speed, which results in excessive noise when reading charges from horizontal elements that include no image data. Applicant's invention obviates this problem by preventing read out of areas that correspond to non-image areas. In this manner, the invention is able to provide a higher read out speed with reduced noise effects.

In an alternative embodiment of the invention, the non-imaging area comprises two portions, with one portion of the non-image area not being read and a second portion of the non-image area being read at a high read-out speed or with a binning operation whereby signals of several pixels in the non-image area become combined and read out together.

As a further feature of the invention, Fig. 8 illustrates an array with an imaging region 45 shifted towards the read out end of horizontal shifter 42.

Turning to the cited art, Lazarev relates to an apparatus for imaging body tissue to include a background portion and a fluorescence portion. The highlighted fluorescent portions are viewed in the surrounding context of the object being viewed. Abstract. Referring to Fig. 1, a light source 16 becomes modulated into a white irradiation light to produce a normal background image and a blue excitation light to stimulate fluorescence in an object 14. More particularly, the fluorescent excitation light is selected to have a spectrum to maximize fluorescence of a contrast dye injected in the object. Col. 4, line 59 to col. 5, line 8. The normal image is processed through image pick up device 22 (col. 5, lines 20-34), and the fluorescent image is processed via a low light level image pick up device 28 (col. 5, lines 34-38). Prior to undergoing image pick up, the fluorescent component due to irradiation of the injected dye is isolated from autofluorescence of body tissue. The bandpass filter 30 passes light for the peak fluorescence value and the bandpass filter 32 minimizes the autofluorescence. Col. 5, lines 47-56. Fig. 3 illustrates bandpass filters 30, 32. The normal image signals become combined with the fluorescent signals to provide a normal image overlaid with the fluorescent image. Col. 5, lines 57-64.

Wilder relates to an image sensor including an array of pixels and a device for selectively varying the number of pixels which are read out, to provide an output of different imaging regions at a different resolution. Wilder teaches imaging an object at a low resolution and selecting a region of interest and re-imaging the region of interest at successively higher levels of resolution. Abstract. An array of pixels has a corresponding row conductor (Fig. 2, Yi) for each row of pixels and a column conductor (Xj) for each column of pixels. The pixels can be grouped and read out at different resolutions by selectively energizing the row and column conductors.

Talmi relates to the detailed structure of an Interline charge coupled device. Talmi describes an apparatus for capturing short duration events, such as emissions of a wavelength of interest which only exist over small intervals of time. Col. 2, line 66 to col. 3, line 5. In particular, a controller precisely times when a charge coupled device begins to accumulate charge and when the charge becomes transferred to a CCD storage element. This is achieved by synchronizing activation of an irradiation source and the expected time for emission activity. Col. 4, line 58 to col. 5, line 3.

The Examiner maintains that the combination of Lazarev and Wilder teaches or suggests each feature of independent claim 3. The Examiner concedes that Lazarev lacks an image control means that operates such that when signal charges are to be read from pixels falling in a non-imaging area, these signal charges are prevented from being read. The Examiner cites Wilder to make up for this deficiency. However, Applicant would maintain that the rejection is not supported for at least the following three reasons.

First, as an initial matter, Applicant would submit that the Examiner's assumption that Lazarev necessarily teaches an imaging area and a non-imaging area is questionable. The Examiner cites Fig. 3 for teaching these two types of areas. However, Fig. 3 merely illustrates two bandpass filters to minimize autofluorescence and to maximum fluorescence of an injected dye. The resulting filtered outputs are provided to a low light level image pick up device. However, it is not clear that the image pick up device spatially divides pixels into an imaging area and a non-imaging area. Rather, the reference suggests that all imaged areas are picked up in order to provide effective contrast to discern fluorescence information from a background.

See Abstract. Therefore, Applicant would submit that Lazarev provides no specific discussion of treating a non-image area of an image sensor as described by claim 3.

Second, as a related matter, Wilder does not correct the above deficiency of Lazarev. Rather, Wilder discusses imaging an area using a resolution and successively applying higher resolutions to view areas of interest. Therefore, even areas outside of the region of interest are initially formed as image-forming areas. Applicant would submit that neither Lazarev nor Wilder relates to treatments of pixels for a non-image forming area.

Third, contrary to the Examiner's contention, Wilder does not teach an image control means such that when signal charges are to be read from an image sensor, signal charges which have been accumulated in non-imaging areas are prevented from being read out. The Examiner cites col. 6, lines 40-44 and col. 17, lines 64-66 for teaching reading of sensor pixels within a region of interest. However, col. 6 merely describes that the apparatus of Wilder is operable in a multi region of interest mode. While the reference does provide special treatment for a region of interest, the reference tells nothing about treatment outside of the region of interest. Rather, the Examiner is speculating that areas outside of the region of interest are not read, corresponding to a non-image area. However, as discussed above, Wilder does provide a low resolution image in order for the original area of interest to be identified in the first instance. Therefore, even areas outside of the region of interest are read. There is nothing in Wilder that suggests a low resolution image outside the region of interest cannot co-exist with a high resolution image within the region of interest. Applicant would argue that Wilder actually teaches providing such multiple resolutions to provide an image that is more simple to analyze. In particular, at Col. 3, lines 29 – 35, Wilder describes that the preferred sensors operate to foveate in a manner

corresponding to human vision, to focus attention at a high resolution on a region of interest while absorbing information at a low resolution in a peripheral area. Accordingly, Wilder suggests imaging both the region of interest and an area outside that region, albeit at different resolutions. The Examiner's reliance on col. 17 merely indicates that some pixels are unread. However, this does not mean that these pixels do not store some prior information, such as a low resolution image outside the region of interest. Any ambiguities in the reference must be construed against the Examiner. Therefore, claim 3 is patentable for at least these reasons.

Because claim 4 includes similar recitations for preventing reading in a non-image area, claim 3 is also patentable for the reasons set forth above in claim 3. Moreover, claim 4 further describes two types of treatments in different regions of the non-image area. The cited art fails to further treat reading of charges for "certain areas" and "other areas" in the non-image region. Therefore, claim 4 is patentable for this additional reason.

Claim 5 is patentable based on its dependency.

With regard to claims 6-7, the Examiner cites Talmi to teach the features of the invention relative to the horizontal shifter. However, at a minimum, Talmi fails to make up for the deficiencies of the primary combination as discussed in the third point of argument set forth above for claim 3. Moreover, contrary to the Examiner's contention, the combination does not teach a fluorescence imaging region located at a position shifted from a center position towards a side of read-out. The Examiner cites Lazarev Fig. 3, element 30 for teaching this feature. However, element 30 corresponds to a bandpass filter that passes image information to an image

pick up device. This has no bearing on the positioning of the imaging area relative to a horizontal shifter. Therefore, claims 6-7 are patentable for this additional reason.

We propose adding claims 9-14 to describe features of the invention more particularly.

In view of the above, Applicant submits that claims 3-7 and newly added claims 9-14 are in condition for allowance. Therefore it is respectfully requested that the subject application be passed to issue at the earliest possible time. The Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Susan Perng Pan
Registration No. 41,239

SUGHRUE MION, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037-3213
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

Date: August 14, 2002

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 13, second paragraph, delete and insert the following new paragraphs.

Figure 1A is a schematic view showing an endoscope system, in which a first embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed,

Figure 1B is a schematic view showing a second embodiment of the fluorescence imaging apparatus of the invention,

Figure 1C is a schematic showing a third embodiment of the fluorescence imaging apparatus of the invention,

Page 14, paragraph bridging page 15, delete and insert the following:

Firstly, an endoscope system, in which a first embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed, will be described hereinbelow with reference to Figure 1A to Figure 5. Figure 1A is a schematic view showing the endoscope system, in which the first embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed. In the endoscope system, in which the first embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed, excitation light is irradiated to a measuring site in a living body, the excitation light causing the measuring site to produce fluorescence. The fluorescence produced from the measuring site is

detected by a CCD image sensor, which is located at a leading end of an endoscope. The thus detected fluorescence image is displayed on a monitor and as a pseudo color image in accordance with a ratio between signal intensities of fluorescence components of the fluorescence, which fluorescence components have wavelengths falling within predetermined wavelength regions. When signal charges having been accumulated in the CCD image sensor, are to be read from the CCD image sensor, signal charges, which have been accumulated in pixels falling within a non-imaging region other than a fluorescence imaging region, are read with a quick reading operation, wherein the signal charges are read at a reading speed higher than the reading speed at which the signal charges having been accumulated in pixels falling within the fluorescence imaging region are read.

Page 29, paragraph bridging page 30, delete and insert the following:

An endoscope system, in which a second embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed, will be described hereinbelow with reference to Figure 1B. The constitution of the endoscope system, in which the second embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed, is approximately identical with the constitution of the endoscope system, in which the first embodiment of the fluorescence imaging apparatus described above is employed. Therefore, only different elements are numbered with different reference numerals in Figure 1B.

Page 36, last paragraph bridging page 37, delete and insert the following:

An endoscope system, in which a third embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed, will be described hereinbelow

with reference to Figure 1C. The constitution of the endoscope system, in which the third embodiment of the fluorescence imaging apparatus in accordance with the present invention is employed, is approximately identical with the constitution of the endoscope system, in which the first embodiment of the fluorescence imaging apparatus described above is employed. Therefore, only different elements are numbered with different reference numerals in Figure 1C.

IN THE CLAIMS:

Claims 9-14 are added as new claims.